

Echinodermata, Ophiuroidea, *Gorgonocephalus* Leach, 1815: First report of the genus for the Brazilian continental margin

Carlos A. M. Barboza^{1*}, Fabricio M. Mendes², Andrea Dalben³ and Luiz R. Tommasi²

1 Universidade Federal do Paraná, Programa de Pós-graduação em Zoologia, Centro de Estudos do Mar, Laboratório de Bentos - Av. Beira-mar s/n. CEP 83255-000. Pontal do Paraná, PR, Brazil.

2 Fundação de Estudos e Pesquisas Aquáticas - FUNDESPA Av. Afrânio Peixoto, 412, Butantã. CEP 05507-000. São Paulo, SP, Brazil.

3 Universidade Federal de Santa Catarina, Departamento de Ecologia e Zoologia, Laboratório de Biogeografia e Macroecologia Marinha. CEP 88040-970. Florianópolis, SC, Brazil.

* Corresponding author. E mail: carlosambarboza@gmail.com

ABSTRACT: The Gorgonocephalidae includes 38 genera, five of them reported for Brazilian waters. *Gorgonocephalus chilensis* has a wide distribution throughout Antarctica and Subantarctic regions and its northern limit was restricted to the coast of Uruguay. This work aims to report the first occurrence of the *Gorgonocephalus* genus for the Brazilian continental margin and extend the northern limit of distribution of *G. chilensis* to the coast of Santa Catarina. Tolerance to a large temperature and bathymetric range are crucial to understand the distributions patterns of ophiuroids from the polar circle that also occur at southern South America.

The Gorgonocephalidae family has a worldwide distribution and occurs from shallow waters to the deep ocean (Paterson 1985; Rosenberg *et al.* 2005). The family comprises 38 valid genera in which only five of them were reported as belonging to the Brazilian continental margin: *Astrotoma agassizii* Lyman, 1875, *Astrocyclus caecilia* (Lütken, 1856), *Astrophyton muricatum* (Lamarck, 1816), *Astrochele lymani* Verrill, 1878 and *Astrogomphus vallatus* Lyman, 1869. *Gorgonocephalus* genus includes ten species (Stöhr and O'Hara 2007) and its northern limit distribution in the South Atlantic was restricted to the coast of Uruguay. *Gorgonocephalus chilensis* has been recorded from Antarctic Peninsula, Ross Sea, Kerguelen Islands, Heard Island, Chile, Argentina, Uruguay and New Zealand. This work reports the first occurrence of the *Gorgonocephalus* genus for the Brazilian continental margin and extended the northern limit occurrence of *G. chilensis* to the coast of Santa Catarina, Brazil (27°17'16" S, 48°20'56" W).

The Arvoredo Island is located in the southern coast of Brazil with an extension of 2.7 Km² of land in a marine protected area (Figure 1). The region hydrodynamic features are strongly influenced by the Superficial Tropical Water (STW) and by the South Atlantic Continental Water (SACW) (Viana *et al.* 1998; Carbonel and Valentin 1999; Rossi-Wongtschowski *et al.* 2006). The STW (0 to 250/300 m depth) is the result of the convergence of the Tropical Water (TW), the Litoral Water (LW) and of periodic upwelling phenomena of the SACW, which has a temperature range between 6 and 18 °C flowing between 300 to 500 m depth (Viana *et al.* 1998). The Intermediate Antarctic Water (IAW) has a high degree of dissolved oxygen, temperatures between 2 and 6 °C and flows between 500 to 1,200 m depth in the study area.

Sampling was conducted by SCUBA diving during October 2004 and totaled 130 hours. One single specimen of *G. chilensis* was collected associated with the Ellisidae (Gorgonacea) octocoral at 21 °C and 20 m depth. This specimen was stored at the echinoderm collection of the Museu de Zoologia of the Universidade de São Paulo, São Paulo, Brazil (MZUSP-18.185).

The disk diameter of the specimen is 28 mm and dorsally covered by a thick skin (Figures 2A and 2B). The radial shields are bar-like reaching the middle of the disk and have a coating of granules (Figure 2C). The oral surface are covered by small granules that are smaller than those of the radial shields (Figure 2D). The jaws are armed with spine-like mouth papillae (Figure 2D). Genital slits are conspicuous and contain small granules along each margin. The slits are localized at the base of each arm on the

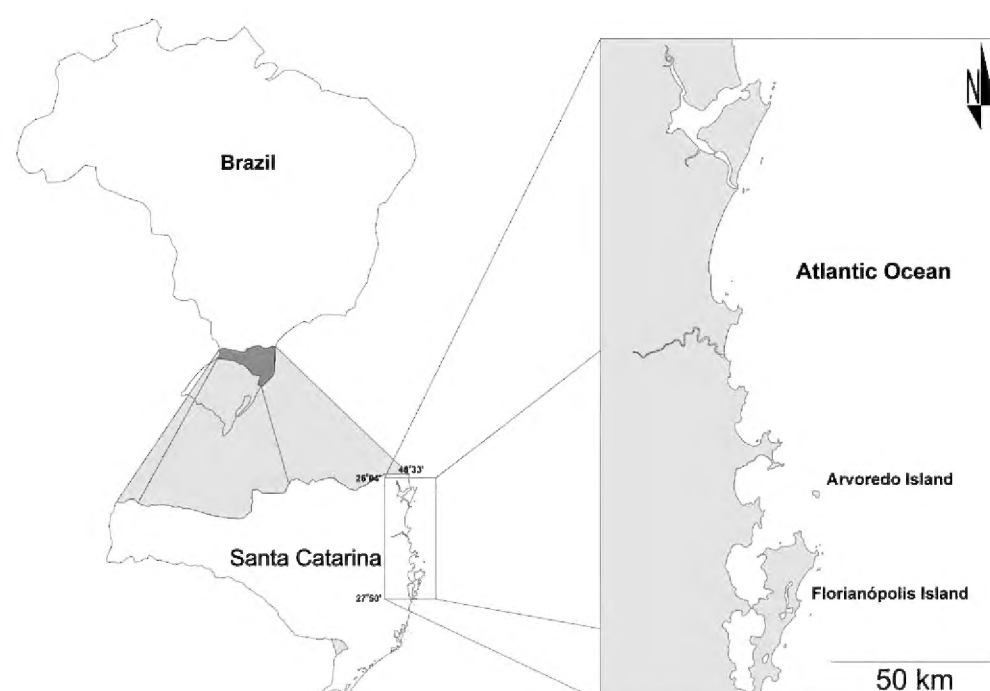


FIGURE 1. Northern coast of Santa Catarina and Arvoredo Island

ventral interradial area (Figure 2E). The arms are densely granulated and the first branch, of the total of five, occurs at the distal edge of the disk. Arms spines are modified into microscopic pointed hooks (Figure 2F) forming rings around the arms. The first two tentacle pore have no tentacle scales associated with it and the follow ones has two to four scales that increases towards the distal segments.

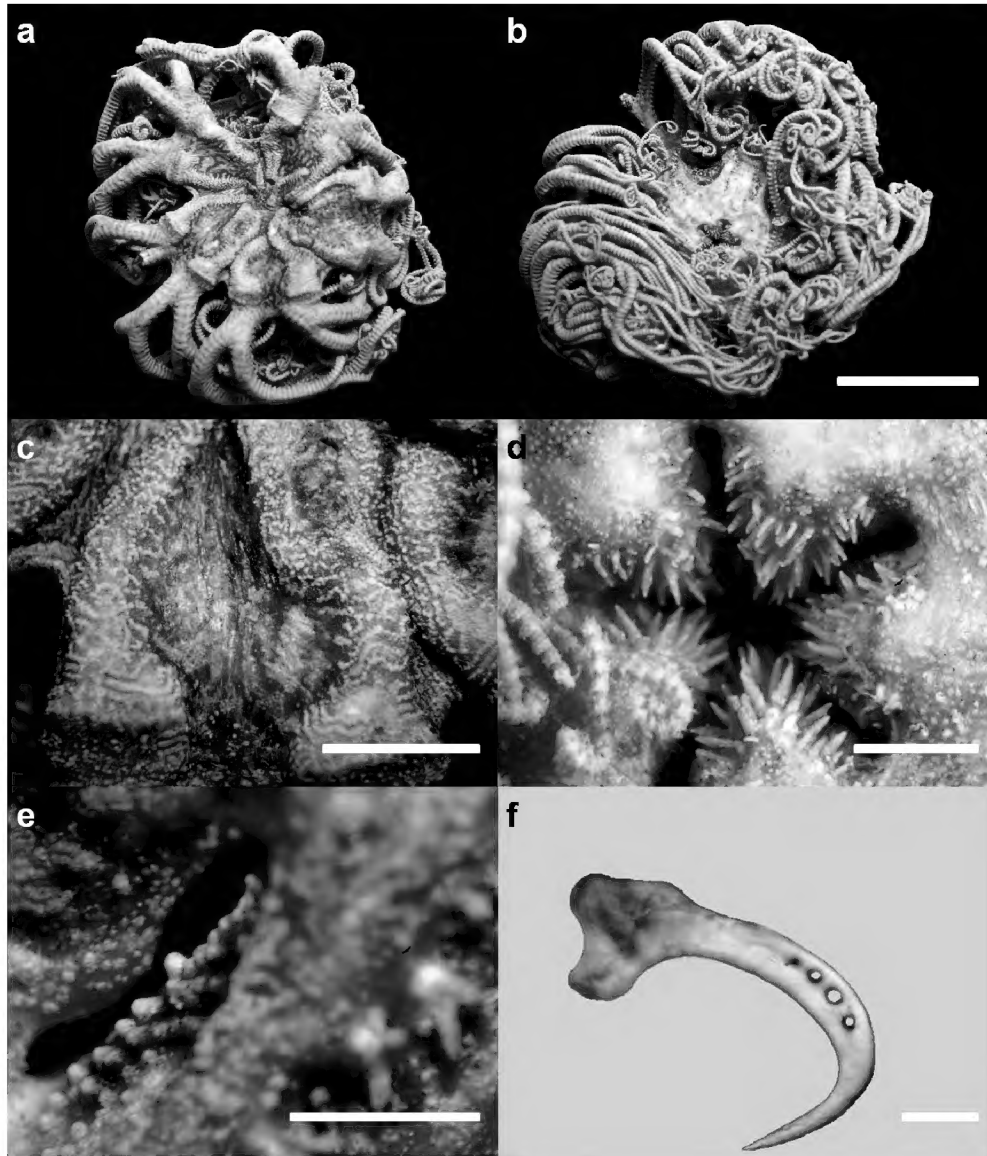


FIGURE 2. *Gorgonocephalus chilensis*. Aboral view (A); adoral view (B); radial shields (C); oral surface and jaws (D); genital slit (E); brachial spine (F). Scales: (A),(B) = 20 mm; (C) = 5 mm; (D) = 3 mm; (E) = 2 mm; (F) = 0,05 mm.

Gorgonocephalus chilensis differ from *Astrotoma agassizii*, *Astrogomphus vallatus* and *Astrochele lymani* due to the presence of branched arms. *Gorgonocephalus chilensis* also differ from *Astrocyclus caecilia* because the later has no spines or tubercles covering the radial shields. *Astrophyton* species extremely resembles *Gorgonocephalus* species, but the former has a more developed radial shields and do not have arms spine on the proximal vertebrae of the arms (Lyman 1875).

The dorsal ornamentation of the disk can vary in shape (spines, granules or tubercles) and in the distribution pattern (Mortensen 1936; Monteiro and Tommasi, 1983 a, b). Mortensen (1936) observed that juvenile individuals may have spines covering all the dorsal surface of the disk although in adult individuals these spines can be almost totally absent. The adult specimen of this study has sparsely distributed tubercles covering only the radial shields. Monteiro and Tommasi (1983 a; b) concluded that the differences belonging to the ornamentation patterns of the disk could not be linked to a latitudinal gradient.

The arm spines morphology of *Gorgonocephalus caput-medusae* differs from the specimen here analyzed due to the presence of one up to three intermediated hooks between the base and the tip of the hooked spine. Rosenberg et al. (2005) argued that the great resemblance between

the morphology of the arm spines of *G. caputmedusae* and *Gorgonocephalus articus* is a possible result of a common origin and so deserving the keeping of a same feeding strategy for the capture of macroscopic plankton like copepods. Probably the hooked spines of *G. chilensis* are also used to feed plankton organisms suggesting a common feeding strategy of *Gorgonocephalus* species.

Distribution patterns of Antarctic echinoderms species can be related to marine currents and the capability of the larvae dispersion (Pawson 1994; Clarke and Johnston 2003). Fell (1962) and Smirnov (1990; 1992) pointed out that many echinoderms species can travel long distances associated with algae wisps. Mortensen (1936) considered that *G. chilensis* has smaller eggs sizes and a greater number of gonads in relation to *Gorgonocephalus eucnemis*, which has a direct development (Patent 1970). This evidence suggest that *G. chilensis* has an indirect development with a pelagic stage. If this is the case, the wide distribution pattern of *G. chilensis* can be related to its larvae dispersion capability.

Ophiuroids can tolerate a wide depth as well as a temperature range (Brey et al. 1996), so the occurrence of Antarctic species at South American and New Zealand continental margins should be expected (Dahm 1999). Dahm (1999) suggested that the submerged ridge, the Scotia Arc, between the Antarctic Peninsula and South America, is the most likely migration route for eurybathic species between the Antarctic region, South America and New Zealand. Antarctic and sub-Antarctic echinoderms, like *G. chilensis*, probably have a wide distribution beyond the polar circle (Pawson 1994). The present report has important biogeography implications to the knowledge of the distribution of *G. chilensis* and support the idea of a closely relationship between Antarctic and the south of South American echinoderm fauna.

ACKNOWLEDGMENTS: We thank Dr. Paulo da Cunha Lana, Msc. Maikon Di Domenico, Msc. Verônica Maria de Oliveira, Msc. Walter Cerqueira, Dr. Roberto Ávila and Dra. Ana Maria Monteiro Gouveia to important contributions to this manuscript.

LITERATURE CITED

- Brey, T., C. Dahm, M. Gorny, M. Klages, M. Stiller and W.E. Arntz. 1996. Do Antarctic benthic invertebrates show an extended level of eurybathy? *Antarctic Science* 8: 3-6.
- Carbonel H.C.A.A. and J.L. Valentin. 1999. Numerical modeling of phytoplankton bloom in the upwelling ecosystem of Cabo Frio (Brazil). *Ecological Modeling* 116 (2): 135-148.
- Clarke, A. and N.M. Johnston. 2003. Antarctic marine benthic diversity. *Oceanography and Marine Biology: an Annual Review* 41(2003): 47-114.
- Dahm, C. 1999. Ophiuroids (Echinodermata) of southern Chile and Antarctic: Taxonomy, biomass, diet and growth of dominant species. *Scientia Marina* 63 (Supl.1): 427-432.
- Fell, H.B. 1962. West-wind-drift dispersal of echinoderms in Southern Hemisphere. *Nature* 193: 759-761.
- Lyman, T. 1875. *Zoological results of the Hassler Expedition II. Ophiuridae and Astrophytidae. Illustrated Catalogue of the Museum of Comparative Zoology* (8). London: Cambridge University Press. 34 p.
- Monteiro, A.M.G. and L.R. Tommasi. 1983a. Ophiuroidea das regiões Antártica e Subantártica, 2. Variação em *Gorgonocephalus chilensis* (Philippi) (Echinodermata, Ophiuroidea, Gorgonocephalidae). *Boletim do Instituto Oceanográfico da Universidade de São Paulo* 32(1): 55-61.
- Monteiro, A.M.G. and L.R. Tommasi. 1983b. Ophiuroidea das regiões Antártica e Subantártica, 1. Sobre três espécies de Gorgonocephalidae e Ophiacanthidae. *Boletim do Instituto Oceanográfico da Universidade de São Paulo* 32(1): 33-54.
- Mortensen, T. 1936. Echinoidea and Ophiuroidea. *Discovery Reports* vol. XIII: 199-148.

- Patent, D.H. 1970. The early embryology of the basket star *Gorgonocephalus caryi* (Echinodermata, Ophiuroidea). *Marine Biology* 6: 262-267.
- Paterson, G.L.J. 1985. The deep-sea Ophiuroidea of the North Atlantic Ocean. *Bulletin of the British Museum Natural History, Zoology* 49: 98-145.
- Pawson, D.L. 1994. Antarctic echinoderms: History, distribution, ecology, 1968 – 1993; p. 99-110 *In*: D. Billet, A. Guille, J.P. Férral and M. Roux (eds.). *Echinoderm through time*. Rotterdam: Blakema.
- Rosenberg, R., S. Dupont, T. Lunda, H.N. Sköld, A. Norkko, J. Roth, T. Stach and M. Thorndyke. 2005. Biology of the basket star *Gorgonocephalus caputmedusae* (L.). *Marine Biology* 148: 43–50.
- Rossi-Wongtschowski, C.L.D.B., J.L. Valentin, S. Jablonski, A.C.Z. Amaral, F.H.V. Hazin and M. El-Robrini. 2006. O Ambiente Marinho; p. 21-78 *In*: C.L.D.B. Rossi-Wongtschowski and A.C.Z. Amaral (eds.). *Programa REVIZEE Avaliação do Potencial Sustentável dos Recursos Vivos na zona Econômica Exclusiva Relatório Executivo Relatório Executivo*. Brasília: Ministério do Meio Ambiente.
- Smirnov, I.S. 1990. Brittlestar fauna (Echinodermata: Ophiuroidea) of the Southern Ocean and influence of the western wind current on brittlestars distribution. *Okeanologicheskoye Issledovaniya Yuzhnogo Okeana*: 165-188.
- Smirnov, I.S. 1992. Types of distribution areas for brittlestars (Echinodermata: Ophiuroidea) of the Southern Ocean. *Fisicheskaya Okeanologiya e Problemy Biologicheskoy Produktivnosti*: 165-188.
- Stöhr, S. and T. O'Hara. 2007. *World Ophiuroidea database*. Electronic database accessible at <http://www.marinespecies.org/Ophiuroidea/index.php>. Captured on 03 February 2010.
- Viana, A.R., J.C. Faugères, R.O. Kowsmann, J.A.M. Lima, L.F.G. Caddah, J.G. Rizzo. 1998. Hydrology, morphology and sedimentology of the Campos continental margin, offshore Brazil. *Sedimentary Geology* 115: 113-157.

RECEIVED: February 2010

REVISED: April 2010

ACCEPTED: April 2010

PUBLISHED ONLINE: May 2010

EDITORIAL RESPONSIBILITY: Luis Ernesto Arruda Bezerra